

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (a) Use the potential energy function $U(x)$ shown in Fig.1 to sketch the corresponding F_x versus x graph. (6%) (b) If the total mechanical energy $E=0$, find the kinetic energies at $x=0$ m and $x=2$ m. (4%)

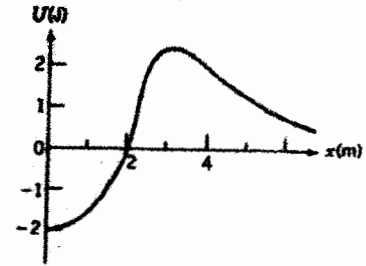


Fig.1

2. A disk, with mass M and radius R , is released at height H then rolls without slipping down an incline, as shown in Fig.2. (a) Show that the moment of inertia of the disk I_{CM} that rotates about the central axis perpendicular to the flat surface is $(1/2)MR^2$. (5%) (b) Ignore dissipative effects, find speed V_{CM} of the disk at the bottom? (5%)

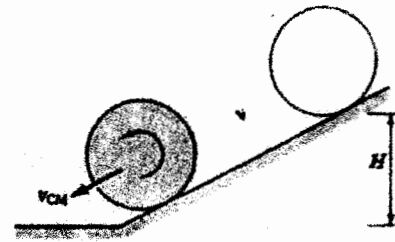


Fig2

3. The path of the planet is an ellipse, as shown in Fig.3. According to *Kepler's second Law* of planetary motion, the line joining the sun to a planet sweeps out equal areas in equal time intervals. Show that this is a consequence of the conservation of angular momentum. (10%)

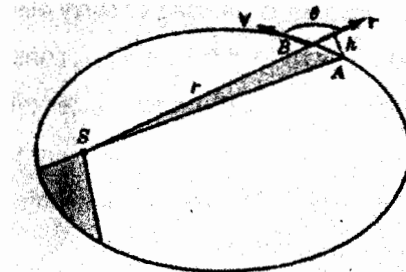


Fig.3

4. Find the field strength at the center of a thin semicircular ring of radius R and mass M , as shown in Fig.4. The linear mass density is λ kg/m. (10%)

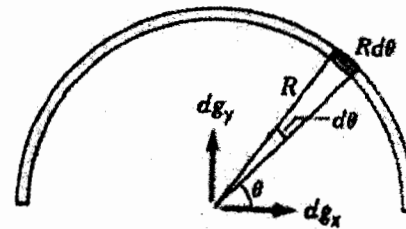


Fig.4

5. A dam has a height H and a width W (see Fig.5). Assuming that the water level reaches the top. (a) Find the net pressure force exerted on the dam. (5%) (b) Calculate the torque experienced by the dam about a point at its base. (5%)

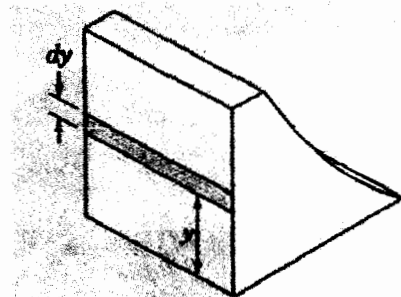


Fig.5

6. A hot liquid is contained within a spherical shell of inner radius a and outer radius b . T_a and T_b are the temperatures at the inner and outer surfaces, respectively. Find that the rate of heat transfer due to conduction. (10%)

7. What is the change in entropy of 500 g of water as its temperature increases from 20 °C to 50°C? The specific heat of water is 4.19 kJ/kg·K. (10%)

8. A cylindrical capacitor consists of a central conductor of radius a surrounded by a cylindrical shell of radius b , as shown in Fig. 6. The outer sheath is grounded and the central conductor has charge Q . Assuming that air is between the plates and the length of the cylindrical capacitor is L . (a) Find the electric field between the plates. (5%) (b) Find the capacitance. (5%)



Fig. 6

9. A *coaxial cable* is often used to carry electrical signals, for example, from an antenna to a TV set. As Fig.7 shows, it consists of an inner wire of radius a that carries a current I upward, and an outer cylindrical conductor of radius b that carries the same current downward. Find the self-inductance of a coaxial cable of length l . Ignore the magnetic flux within the inner wire. (10%)

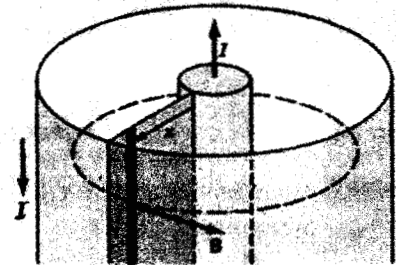


Fig. 7

10. What is the Ampere-Maxwell law? (4%) Use the Ampere-Maxwell law to find the magnetic field between the circular plates of a parallel-plate capacitor that is charged by $Q(t)$, see Fig.8. The radius of the plates is R and the separation between the plates is d . Ignore the fringing field. (6%)

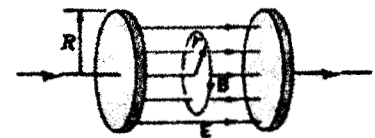


Fig. 8